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DIRECTORATE OF
INTELLIGENCE

Intelligence Memorandum

Production Of Computers In The USSR

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
July 1971

INTELLIGENCE MEMORANDUM

PRODUCTION OF COMPUTERS IN THE USSR

Conclusions

1. The Soviet computer industry is a troubled and lagging sector of the Soviet economy. The production of computers in the USSR in 1970 amounted to about 800 units compared with about 16,000 in the United States. During 1955-69 the USSR produced an estimated 5,200 digital computers; the US total was about 90,000. Soviet computers currently in production are fitted with obsolescent transisters. Serial production of third-generation models, using integrated circuits, has not yet been started. Soviet computers have been designed primarily for scientific uses, and, because of their relatively small internal memory capacities, even the largest are not well suited for data processing.

2. Soviet computers have low productivity and are difficult to use compared with modern Western counterparts. The large divergence in characteristics of models in use reduces the possibilities for using standard programs in the USSR. Moreover, because of the large amount of handwork used in production and assembly, machines of the same model sometimes differ enough in circuitry that they cannot employ the same programs.

3. Because the factories provide little service after delivery, users frequently must repair or modify their own machines, and, in the process, they create non-standard computers on which standard programs will not run. Documentation needed to operate and maintain Soviet computers is inadequate and unreliable. Soviet computer producers do not provide their customers with instruction in systems analysis or programming. Often computers are not put into operation for months, because there is no one to program them or to devise data management systems appropriate for their use.

4. Soviet computers are frequently out of service because of component failure or breakdown of peripheral equipment. Input-output

Note: This memorandum was prepared by the Office of Economic Research and coordinated within CIA.

equipment is slow, and external memories on magnetic tape are troublesome because of problems in tape drives and the low quality of Soviet magnetic tape. Central processors, which do well in solving scientific and engineering problems, lack the large internal memories that are required for efficient solution of data handling problems. And scientific users, who have the training and technical experience, have been much more successful in computer use than financial and business users.

5. The Soviet computer industry is short of modern production equipment and has a low standard of quality control compared with the Free World. The electronics industry of the USSR is still unable to supply computer producers with the numbers of integrated circuits needed to establish quality production of third-generation equipment. The production problems in computer assembly are equally severe. Because of years of neglect of the business machines and communications equipment industries, the card handling, line printing, and other peripheral equipment that they supply is not of good quality.

6. In 1964 the computer industry was reorganized in order to improve coordination among design, production, and using organizations. Plans were laid to reduce the number of models in production and achieve a large-scale modern production technology by manufacturing two families of third-generation computers (containing integrated circuits). These are the RYAD and ASVT series, to be delivered in different sizes by altering the number of standard modules incorporated into individual installations. The design principles of the IBM-360 series were specified because of its success as a mass produced data handling computer and in the hope of being able to use IBM-360 programs, now constituting the world's largest collection.

7. The USSR is presently engaged in a campaign to acquire from the Free World the modern electronics production technology which it desperately needs to support its computer industry. Special efforts are directed toward acquiring manufacturing technology for mass production of integrated circuits and high-precision printed circuit boards. COCOM regulations and US unilateral export control policy have so far denied the USSR access to this production technology. Despite the excellence of Soviet scientists, the Soviet economic system does not rapidly move this knowledge into developed products which can then be placed in industrial production.

8. If the USSR can purchase modern production equipment and technical knowhow from the Free World, it may be able by 1975 to proudce a computer suitable for economic data processing. However, the Soviet computer would still be a copy of one whose production was mastered in the United States in 1964.

Discussion

Introduction

9. The Soviet computer industry is a troubled and lagging sector of the Soviet economy. Production volume is far below requirements, and the USSR finds it necessary to obtain computers for high-volume data processing from the Free World. Soviet scientists devised electronic computers almost as early as did Western scientists, but Soviet industry has not been able to keep pace with the United States, Western Europe, and Japan in either volume of output or quality of product.

10. Soviet equipment design is at least a design generation behind that of the United States. However, the worst problems are not in design, per se, but in (1) the backwardness in the technology of mass production of computers, components, and other associated equipment; and (2) what might be called the technology of mass utilization, including training, installation, maintenance, and software.

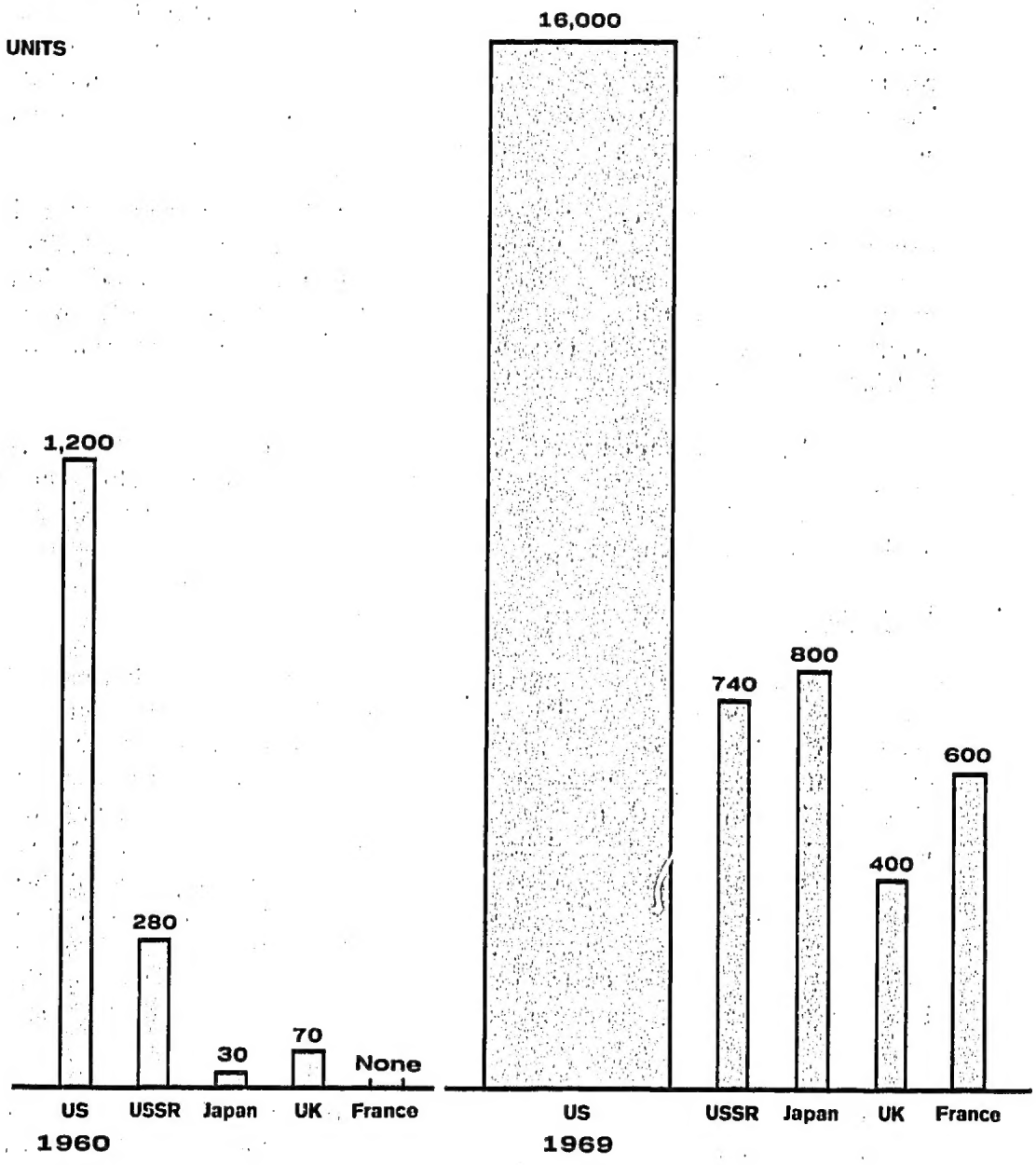
11. This memorandum surveys the Soviet computer industry -- its production and product mix, the problems of production technology, and utilization -- and examines Soviet plans and efforts to achieve an efficient level of computer technology and application.

Production

12. The production of digital electronic computers of all types in the USSR in 1970 amounted to about 800 units with a total value of about 150 million rubles (see Table 1). The average annual rate of growth of the value of output in the period between 1965 and 1969 has been about 21%. This growth rate is slightly above that of the US computer industry during that period. Because of slow early development, Soviet computer output by 1969 was less than 5% of US output in both physical and value terms. During 1955-69 the USSR produced an estimated total of about 5,200 digital computers, compared with 90,000 produced by the United States. (For a comparison of annual computer production in the USSR with the United States and other Free World countries, see the chart and Table 2.)

13. The faster development of the US computer industry was facilitated by access to widely based and vigorous competitive electronics and precision mechanics industries as well as by active promotion of the large market for computers for processing business data. The USSR, on the other hand, under central planning, experienced excessive delay in introducing new electronic component technology into commercial-scale production. Moreover, during the 1950s, the priorities on resource

Annual Production of Digital Computers in Selected Countries, 1960 and 1969



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allocations for the computer industry were limited to those necessary for satisfying the country's scientific and engineering requirements.

14. Only in the early 1960s did the Soviets recognize the usefulness of large numbers of computers for data processing and substantially raise the priorities of the industry. The program initiated then to develop and produce an appropriate data processing computer is only now showing promise of fruition. Success in this effort cannot be achieved before the Soviets solve their current problems with the mass production of integrated circuits.

15. Eight Soviet plants have been identified as significant producers of computers (see Table 3). These include the Computing and Analytical Machines Plants at Penza and Moscow where Soviet digital computer production was initiated in 1955 (at least three years after production started in the United States). Both of these plants are old facilities which formerly produced low-quality electromechanical and manual office machines.

16. Although the Moscow and Penza plants are still among the most important computer production facilities, the Minsk plant is probably the USSR's largest producer. It was the first to establish significant production of transistorized computers, and, although its products are best suited for scientific and engineering applications, many Minsk computers are in use for data processing purposes. The computer plants in Kazan, Kiev, Severodonetsk, Vilnius, and Yerevan, while significant producers, are believed to produce on a smaller scale than either Minsk or Penza.

17. The Minsk-22 (and its earlier version, the Minsk-2) probably is the single most important computer that the USSR has been able to produce. (For model production, by plant, see Table 3). It is a medium-scale, transistorized machine, in some ways resembling the IBM-704. Although developed for scientific use, it is the best medium-scale Soviet computer for data handling and is widely used in the USSR for that purpose. Production of the Minsk-22 is now being reduced in favor of its successor. Minsk-32. The Minsk-32 has a larger memory and higher operating speed which better fit it for data handling.

18. The USSR produces only one computer that can be designated a large-scale machine. This is the BESM-6, produced at the Moscow plant. Thirty-two had been produced by the end of 1970 (see Table 4). This, too, is basically a scientific computer but has a smaller memory capacity, slower speed, and less reliable input-output equipment than large-scale Western computers.

19. Typical of the small-scale Soviet computers, used mostly for scientific and engineering work, is the Mir-1. This computer, produced from

1966 through 1969, was priced at 50,000 rubles and compares unfavorably with US computers, such as the Hewlett-Packard Model 9100-A, which can do nearly the same job and costs only about $5,000. Moreover, the Mir-1 is oversized, slow, and unreliable by US standards.

20. The Nairi models and the Promin-1 are small scientific computers similar to the Mir-1. The Ural-1 is a small-scale scientific computer, somewhat similar in capabilities to the IBM-650. The Ural-2 is larger, but both the Ural-1 and the Ural-2 are vacuum tube machines. A major disadvantage of the Ural-2 stems from its being mostly handmade, with no two machines exactly alike. As a consequence, standard programs cannot be used on all Ural-2s.

Level of Technology

21. All Soviet digital electronic computers currently in production are fitted with transistors. Computers using vacuum tubes were phased out of production in 1964, and the serial production of third-generation computers, using integrated circuits, has not yet been established. Compared with modern US computers, most of which embody integrated circuits, Soviet computers are much slower, less reliable, and less productive.

22. The logical design of Soviet computers is rather good. In most cases, however, full advantage of the capabilities of the central processing unit (CPU) cannot be taken, because of insufficient internal memory and inadequate peripheral equipment. For example, the most powerful Soviet computer, the BESM-6, is prevented from operating at full capacity because of its limited internal memory, the lack of magnetic disc stores, poor magnetic tape drives, poor quality tape, and slow, unreliable input-output equipment.

23. Soviet computer performance is weakest in the area of peripheral equipment. This equipment, which consists primarily of punch card and tape handling equipment, line printers, magnetic tape handling equipment, drum and disc memories, and keyboard equipment, suffers from the poor development in the USSR of the production of precision mechanical products. It shares its low quality with Soviet office machines, which include some of the world's most archaic typewriters and bookkeeping machines. In addition to preventing the central processors from reaching their designed capabilities, as mentioned above, Soviet peripherals are to blame for most in-service failures of Soviet computers. This circumstance contributes further to the low rates of utilization of computers in the USSR. Lack of good peripherals also retards the development of new computers. Developmental testing of a new CPU is almost impossible when communications with the CPU continually break down and interrupt the tests, or are inadequate for testing the CPU at maximum operating levels.

24. Serious institutional problems hamper the design of producible computers and their introduction into production. The typical Soviet computer is designed by a research institute and, after acceptance by a government committee, is assigned to a computer plant for production. The designers pay insufficient attention to incorporating features that will facilitate the production of the machine in quantity and there is no systematic cooperation with the producing enterprise during the start-up period.

Production Technology

25. Most Soviet computers are produced in small batches, with excessive hand work measured by US standards. (For production by model, by year, see Table 5.) Careful examination of Soviet computers by US experts indicates that little advantage is taken of automated techniques such as machine insertion of electronic components, flow soldering, automatic back panel wiring, and computerized testing of circuits. Moreover, Soviet computer producers must fabricate common hardware items themselves. Western visitors to Soviet computer plants report that true serial production does not exist, but that batches of 20 or so machines are assembled as a group.

26. Although it might be expected that a command economy could standardize computer products and achieve substantial economies of scale in their production, the USSR does not realize these economies in practice. Despite the priority now assigned to computer production, too many different models have been introduced, thus reducing the opportunities for specialized large-scale output of subassemblies.

27. Because of poor quality control, Soviet computers are delivered with substantial numbers of defects. Computer plant managers apparently have been willing to relax the tight quality standards required for the finished computer to function properly in order to attain planned levels of output.

28. The seriousness with which the Soviets themselves view their computer production problems is best demonstrated by their repeated attempts to purchase from Western firms the complete manufacturing equipment and technology required to mass produce modern computers. These attempts have included requests for complete plants for the production of the integrated circuits used in third-generation computers. The implication is clear that the Soviet themselves cannot yet supply sufficient quantities of appropriate integrated circuits to support a large computer industry.

29. Western experts have examined Soviet peripheral equipment and report that it is not built to sufficiently close tolerances and does not incorporate modern metallurgy where required for durability under high-speed operating conditions now demanded of modern computers.

30. The USSR currently purchases peripheral equipment from Eastern Europe to supplement its own inadequate production capability – for example, it buys input typewriters from East Germany. In the Soviets' new production programs, they plan to rely even more heavily on Eastern Europe for such peripheral equipment as line printers and punch card and punch tape equipment for input and output purposes. Much of this equipment is now being produced in Eastern Europe under Western license.

Utilization

Installations

31. A tabulation of all installations of Soviet digital computers, reported by the end of 1970, contains more than 1,200 entries. Analysis of this sample, amounting to about 20% of total Soviet computer production, confirms the view that computers have been used by the USSR principally for scientific purposes. The following tabulation arrays known Soviet computer installations according to the activity they support.

Activity	Number of Computers	Percent
Government administrative organs	168	14
Scientific research institutes and organizations	601	49
Military organizations	22	2
Production organizations	314	26
Educational institutions	115	9
Total	*1,220*	*100*

32. A sample of this size is likely to be representative of applications of computers in the non-military activities of the USSR. Because of the secrecy surrounding Soviet military activity, the figure of 2% probably understates the military share of Soviet computers. Because both scientific research institutes and educational institutions, and probably some factories as well, require computers for problem solving, at least 60% of the computers in the sample are probably employed as scientific machines. Most of the data handling applications are made by government administrative

organs and production organizations. The proposed national computer network is designed to tie together many of the data processing machines of these two groups to expedite national statistical collection and processing.

Computer Performance

33. The performance of Soviet computer installations is very unsatisfactory, even by Soviet standards. Unreliability of equipment leads to frequent in-service failure and greatly limits its available computing time. For critical applications the extraordinary precautions reported by Soviet scientists as necessary to assure acceptable performance amount to redundancies of equipment that would be considered excessive in the West.

34. The unwillingness of computer factories to provide service and support creates one of the most serious problems of Soviet computer users. Many customers even have to install their computers themselves. Since the equipment frequently comes with numerous defects, this causes serious delays in getting it into operation. The expedient repairs made by users sometimes result in changes in circuitry that prevent the repaired computer from running programs written for similar machines. Factories do not provide adequate training courses in maintenance or programming of their products. Operator and maintenance manuals tend to be superficial and error ridden. Although this deficiency has been noted in the directives for the Ninth Five-Year Plan and is slated for correction in the new plan period, it is unlikely that it can be corrected while the Soviet system continues to reward factories for meeting production targets and gives little financial incentive to provide after-sales services.

35. The factories also, for the most part, fail to provide a library of basic programs and sub-routines for their machines. Moreover, they do not provide a medium for disseminating users' experiences nor take the initiative in organizing user groups for the exchange of experiences and programs. This situation contrasts markedly with the organization of the Western computer market, in which the producers vigorously promote their machines by developing programming languages, basic programs, and courses of instruction in maintenance, operation, and programming of computers, and make available specialists in systems analysis to study the customer's problems and specify – not just the most appropriate equipment but entire systems of paperwork management that will be compatible with computerized data handling.

36. The severe shortage of operators, maintenance mechanics, and programmers seems destined to continue for some time because the effort devoted by educational institutes to the training of such personnel is not yet nearly large enough. Moreover, the shortage of systems analysts and

the low level of competence of such people in the USSR are equally serious factors in the inability of Soviet computer users to exact an acceptable level of performance from their installations. By US standards, many Soviet computerized information handling and management systems are fairly primitive and fail to exploit the potential of the installed equipment. Very few Soviet firms have developed advanced production management systems based on mechanized data handling, such as would be possible using only punch card systems, and consequently have little local capability to get the most out of their new computers.

37. Soviet scientific institutions and other users of computers for scientific and engineering purposes generally have less trouble putting new computers into service than do financial and statistical institutions or plant managements. This reflects the fact that computers were long considered a tool of science, and scientists got the lion's share of instruction in computer theory and practice. Moreover, Soviet computers are best adapted to scientific problem solving. However, Soviet scientists typically express great dissatisfaction with the quality and capability of Soviet computer hardware. They are particularly dissatisfied with the lack of adequate internal memories and the slowness and unrealiability of the input-output equipment.

Remedial Programs

38. The Soviet computer industry has received increased attention since 1964, and efforts have been made to solve the major problems hampering the production and applications of computers. A number of new organizations and committees affiliated with major universities and institutes were established as a means of increasing the general level of interest in computers in the Soviet scientific and academic communities. The Soviet press also referred to user groups, formed to raise the level of application of computers through the exchange of experiences and programming knowledge. The design of new models of computers without prior ministerial approval was forbidden. Some improvement in coordination among design, production, and using organizations as a result of intensified official interest in the industry is reflected in the development program of the new RYAD series of computers.

39. In keeping with the decision to reduce the number of types of computers introduced into production, the Soviets decided in the mid-1960s to produce two basic families of third-generation computers. These are the RYAD series for data processing and general scientific problem solving and the ASVT series for process control. These computers are to be of modular design and adaptable to large-volume production.

40. In designing the RYAD and ASVT computers, a deliberate effort was made to copy the "architecture" of the IBM-360 series, and, at least in the case of RYAD, to employ integrated circuits in the CPU. The Soviets hoped to avoid much normal development expense and loss of time by using IBM's designs for computers and software of proven quality. They hoped to begin producing small and medium-scale computers and associated peripheral equipment by the beginning of the 1970s and to satisfy their most pressing needs for computers for data processing and process control by 1975. They also hoped to save large amounts of time and money, otherwise required to develop programs, by using existing software prepared for the IBM-360 machines. However, the process of rewriting IBM programs to run on Soviet computers is not likely to be cheap and quick.

41. The decision to copy IBM-360 type machines may have alleviated design problems, but the production technology is still missing. Even if they are able to design a reliable series which matches the performance of the 360 series, they are not likely soon to match the high production rates of the 360 series, unless they can buy production technology and equipment from the West.

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43. The Soviets have recognized the fact that the programs for producing RYAD and ASVT will not solve all of their computer problems and will contribute little to closing the gap between their computer industry and that of the United States. If successfully put into production by 1975, the RYAD and ASVT would still represent a technology new in the United States in 1964 and far outdated by 1975 standards. The Soviets are making more frequent and continuing attempts to import modern machines and technology from the Free World, either directly or through their CEMA partners. This is especially true of technology for integrated circuits. However, most of the technology is under COCOM regulations or US unilateral export control.

44. In addition to importing carefully selected Free World computers, while the RYAD machines are being perfected, the Soviets are attempting to adapt available domestic hardware to their current needs. For the most part this means attempting to develop data processing systems based upon ill-suited scientific machines such as the Minsk-22. These applications never will be wholly satisfactory, and when data processing machines like those of the RYAD series finally become available, little of the software prepared for the older machines will be transferrable.

APPENDIX

Statistical Tables

Methodology for the Tables

Estimated total physical production of Soviet digital computers was obtained by summing annual production figures, by model. Annual production figures, by model, were estimated on the basis of highly fragmented production reports or known installations of computers, whichever was greater. A great deal of interpolating was done on the basis of estimated plant capacities, dates when series production began, dates when series production ended, and occasionally from available total model production figures.

Values of production figures were derived by multiplying the physical output of each model by the estimated price of that model. Prices of Soviet computers have been announced in the Soviet press in some cases and in other cases have been estimated from Soviet offers to export computers. For computers for which no information on price was available, estimates of price are based on similarities to Soviet computers for which prices are known.

Table 1

USSR: Estimated Annual Production and Value of Production of Digital Computers

Total	Production (Units)	Value of Production (Million Rubles)
1955	15	7
1956	70	16
1957	130	10
1958	160	10
1959	290	22
1960	280	31
1961	260	45
1962	310	61
1963	350	68
1964	390	73
1965	470	64
1966	510	36
1967	550	91
1968	660	107
1969	740	139
1970 a/	800	150
Total b/	*6,000*	*1,000*

a. Data for 1970 are less complete than for other years.
b. Because of rounding, components may not add to the totals shown.

Table 2

Selected Countries: Annual Production of Digital Computers

Units

Country	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
United States	185	400	800	800	1,300	1,200	2,400	4,500	4,500	8,000	7,000	14,000	13,000	15,000	16,000
USSR	15	70	130	160	290	280	260	310	350	390	470	510	550	660	740
Japan	--	--	2	3	9	30	50	140	290	320	370	270	700	520	800
United Kingdom	--	--	--	--	--	70	70	80	110	140	200	250	300	350	400
France	--	--	--	--	--	--	--	--	--	200	200	300	500	500	600

Table 3

USSR: Major Plants of the Computer Industry a/

Plant Name	Output	
	Computers	Peripherals
Minsk Computing and Analytical Machine Plant (SAM)	M-3 Minsk-1 Minsk-2 Minsk-22 b/ Minsk-23 Minsk-32 b/	Tape readers
Penza Computing and Analytical Machine Plant (SAM)	URAL-1 URAL-2 URAL-4 URAL-11 b/ URAL-14 b/ URAL-16 b/	Line printers Tape readers Magnetic drums
Moscow Computing and Analytical Machine Plant (SAM)	BESM-2 b/ BESM-3M BESM-4 BESM-6 M-2 M-20 M-220 b/ STRELA URAL-1 URAL-2	
Kazan Computing and Analytical Machine Plant (SAM)	BESM-2 BESM-2M M-20 M-220 b/	Line printers
Kiev Electronic Computer and Control Machines Plant (VUMS)	DNEPR-1 DNEPR-2 b/ MIR-1 MIR-2 b/	Magnetic tape units Tape readers Card readers Line printers

Table 3

USSR: Major Plants of the Computer Industry a/ (Continued)

Plant Name	Output	
	Computers	Peripherals
Yerevan Experimental Electronic Computing Machines Plant	ARAGATS ERA NAIRI-1 NAIRI-2 b/ NAIRI-3 b/ RAZDAN-1 RAZDAN-2 RAZDAN-3 b/ YEREVAN	Magnetic drums
Severodonetsk Computer Plant	KVM-1 M-1000 b/ M-2000 b/ M-3000 b/ PROMIN UM-1	Tape readers Tape punches
Vilnius Computing Machines Plant	ATE-80 EV-80-3 RUTA-110 b/	Tape readers

a. *Plants are listed according to the volume of output.*
b. *Machines probably in current production.*

Table 4

USSR: Estimated Cumulative Production, Prices, and Value of Production of Digital Computers by Model

Model	Total Production (Units)	Estimated Price (Thousand Rubles)	Value of Production (Thousand Rubles)
ARAGATS	6	250	1,500
ATE-80	20	60	1,200
BESM-1	N.A.	500	N.A.
BESM-2	50	350	17,500
BESM-2M	105	350	36,750
BESM-3	210	200	42,000
BESM-3M	N.A.	200	N.A.
BESM-4	70	300	21,000
BESM-6	32	3,000	96,000
DNEPR-1	128	100	12,800
DNEPR-2	80	125	10,000
ERA	100	300	30,000
EV-80-3	60	36	2,160
M-3	200	18	3,600
M-20	80	500	40,000
M-220	120	600	72,000
MINSK-1	300	70	21,000
MINSK-2	310	200	62,000
MINSK-22	310	250	77,500
MINSK-23	41	255	10,455
MINSK-32	47	300	14,100
MIR-1	250	50	12,500
MIR-2	150	70	10,500
NAIRI-1	600	70	42,000
NAIRI-2	400	80	32,000
NAIRI-3	N.A.	90	N.A.
PROMIN-1	350	25	8,750
PROMIN-2	N.A.	35	N.A.
RAZDAN-1	32	150	4,800
RAZDAN-2	75	170	12,750
RAZDAN-3	150	200	30,000
RUTA-110	45	60	2,700
STRELA	15	1,000	15,000
URAL-1	460	55	25,300
URAL-2	400	120	48,000
URAL-3	N.A.	200	N.A.
URAL-4	160	350	56,000
URAL-11	300	100	30,000
URAL-14	180	145	26,100
URAL-16	50	600	30,000

Table 5

USSR: Estimated Annual Production of Digital Computers by Model

Units

Model	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970 a/	Total
ARAGATS	--	1	1	2	1	1	--	--	--	--	--	--	--	--	--	--	6
ATE-20	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	20
BESM-2	5	10	10	10	10	5	--	--	--	--	--	--	--	--	--	--	50
BESM-2M	--	--	--	--	--	5	10	15	15	15	15	15	15	--	--	--	105
BESM-3	--	--	--	--	--	--	--	--	--	30	30	30	30	30	30	30	210
BESM-4	--	--	--	--	--	--	--	--	--	10	10	10	10	10	10	10	70
BESM-6	--	--	--	--	--	--	--	--	--	--	1	2	4	5	10	10	32
DNEPR-1	--	--	--	--	--	--	--	10	20	20	25	25	20	8	--	--	128
DNEPR-2	--	--	--	--	--	--	--	--	--	--	--	5	15	20	20	20	80
ERA	--	--	--	--	--	10	20	20	20	30	--	--	--	--	--	--	100
EV-80-E	--	--	--	--	--	--	5	10	15	20	10	--	--	--	--	--	60
M-1	--	--	20	50	70	60	--	--	--	--	--	--	--	--	--	--	200
M-20	--	--	--	--	10	20	20	20	10	--	--	--	--	--	--	--	80
M-220	--	--	--	--	--	--	--	--	--	10	10	20	20	20	20	20	120
MINSK-1	--	--	--	--	50	100	100	50	--	--	--	--	--	--	--	--	300
MINSK-2	--	--	--	--	--	--	--	10	50	70	90	90	--	--	--	--	310
MINSK-22	--	--	--	--	--	--	--	--	--	--	--	20	50	90	100	50	310
MINSK-23	--	--	--	--	--	--	--	--	--	--	--	1	10	10	10	10	41
MINSK-32	--	--	--	--	--	--	--	--	--	--	--	--	--	2	20	25	47
MIR-1	--	--	--	--	--	--	--	--	--	--	--	15	85	100	50	--	250
MIR-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	100	150
NAIRI-1	--	--	--	--	--	--	--	--	--	--	100	100	100	100	100	100	600
NAIRI-2	--	--	--	--	--	--	--	--	--	--	--	--	--	50	150	200	400
PROMIN-1	--	--	--	--	--	--	--	--	--	50	75	75	75	75	--	--	350
RAZDAN-1	--	--	--	--	--	2	10	20	--	--	--	--	--	--	--	--	32
RAZDAN-2	--	--	--	--	--	--	--	5	20	20	20	10	--	--	--	--	75
RAZDAN-3	--	--	--	--	--	--	--	--	--	--	--	10	25	25	40	50	150
RUTA-110	--	--	--	--	--	--	--	--	--	--	--	--	--	10	15	20	45
STRELA	5	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15
URAL-1	5	50	100	100	150	55	--	--	--	--	--	--	--	--	--	--	460
URAL-2	--	--	--	--	--	20	80	100	150	50	--	--	--	--	--	--	400
URAL-4	--	--	--	--	--	--	20	50	50	40	--	--	--	--	--	--	160
URAL-11	--	--	--	--	--	--	--	--	--	20	50	50	50	50	50	30	300
URAL-14	--	--	--	--	--	--	--	--	--	5	10	20	35	50	50	10	180
URAL-16	--	--	--	--	--	--	--	--	--	--	--	10	10	10	10	10	50

a. Data for 1970 are less complete than for other years.